NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATEWIDE PLANNING BRANCH

FOUR OAKS THOROUGHFARE PLAN TECHNICAL REPORT

1993

FOUR OAKS THOROUGHFARE PLAN TECHNICAL REPORT

MARCH 1993

Prepared by:

North Carolina Department of Transportation
Division of Highways
Statewide Planning Branch

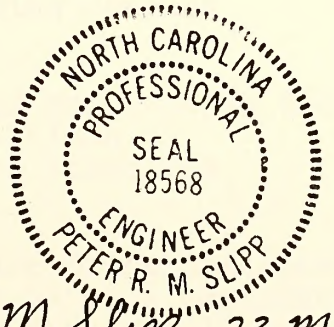
In cooperation with:

United States Department of Transportation
Federal Highway Administration

Town of Four Oaks

Produced by:

Statewide Planning Branch Manager:	M. R. Poole, Ph.D.,P.E.
Thoroughfare Planning Engineer:	A. B. Norwood, P.E.
Project Engineer:	P. R. M. Slipp, P.E.
Technician:	J. M. Neely



Peter RM Slipp 23 March 1993

80 copies of this report were produced at a cost of $102.74 or $1.28 per copy. (NCGS-143-170.1)

CONTENTS

FIGURES

TABLES

INTRODUCTION

This report documents the findings of a study of Four Oaks' thoroughfare system which began in 1990 and resulted in the mutual adoption of the Four Oaks Thoroughfare Plan in 1991. The Town of Four Oaks did not have a thoroughfare plan prior to this date.

Staff personnel from the North Carolina Department of Transportation met with the Four Oaks Planning Board during two of their regular meetings to discuss thoroughfare planning principles, provide technical information, and receive local input on the goals and desires of the community. The Department also met twice with the Four Oaks Board of Commissioners to provide them with information and to receive guidance on the recommended plan developed by the Four Oaks Planning Board. The Department held a public information workshop for interested citizens to receive their input on the recommended plan; citizen comments were very favorable. The Board of Commissioners conducted a public hearing on the recommended thoroughfare plan and adopted it thereafter.

Projected travel was the basis for the development of the thoroughfare plan. Alternatives were developed using the basic thoroughfare planning concepts described in Chapter 2 with consideration given to feasibility, local needs, and environmental impacts. Every effort was made to use as much of the existing street system as possible to minimize costs and environmental impacts.

The recommended street cross sections are based on expected traffic volumes. Before construction, a detailed review of each project must be made to insure that changing conditions have not affected the recommendations.

The recommended improvements are shown with their costs and benefits to define a recommended order of implementation. Responsibility for the proposed construction projects will be shared by the Town of Four Oaks and the State of North Carolina. In order for the plan to be effective, the Town and the State must procure in advance or protect by legal controls the rights-of-way necessary for the proposed improvements. The thoroughfare plan was based on the anticipated growth of the urban area. Actual growth rates and patterns may differ somewhat from those logically anticipated, and it may become desirable to accelerate or retard the development of thoroughfares or to make revisions to the plan to accommodate such variations in urban development. The entire plan may need to be reviewed in detail every 10 years or so to bring it into line with changes in the rate of development and with other comprehensive plans for the area. The thoroughfare plan should be consistent with other components of a comprehensive plan for the development of the urban area.

THIS PAGE INTENTIONALLY LEFT BLANK

THOROUGHFARE PLANNING PRINCIPLES

OBJECTIVES

The urban street system typically occupies 25 to 30 percent of the total developed land in an urbanized area. Since the system is permanent and expensive to build and maintain, much care and foresight must be exercised in its development. Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel needs within the urbanized area.

The primary purpose of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with changing travel demands. Proper planning for street development can avoid costly and needless expense. A thoroughfare plan will enable street improvements to be made as traffic demands increase and help to eliminate unnecessary improvements. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained, requiring a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population and commercial enterprises affects major street and highway locations. Conversely, the location of major streets and highways within the urbanized area can influence the urban development pattern.

Other objectives of a thoroughfare plan include:

1. To provide for the orderly development of an adequate major street system as land development occurs;

2. To reduce travel and transportation costs;

3. To reduce the cost of major street improvements to the public through the coordination of the street system with private action;

4. To enable private interests to plan their actions, improvements, and developments with full knowledge of public intent;

5. To minimize disruption and displacement of people and businesses through long-range advance planning for major street improvements;

6. To reduce environmental impacts, such as air pollution, resulting from transportation activities;

7. To increase travel safety.

Thoroughfare planning objectives are achieved by improving the operational efficiency of thoroughfares and by improving the system efficiency through system coordination and layout.

OPERATIONAL EFFICIENCY

A street's operational efficiency is improved by increasing the capability of the street to carry vehicular traffic. A street's capacity is defined as the maximum number of vehicles which can pass a given point on a roadway during a given period of time under the prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, the nature of the traffic, and the weather.

Physical methods to increase vehicular capacity include street widening, intersection improvement, vertical and horizontal alignment improvement, and roadside obstacle elimination. For example, widening a street from two to four travel lanes more than doubles its capacity by providing additional maneuverability for traffic. Impedances to traffic flow caused by slow moving or turning vehicles and by adverse horizontal and vertical alignments are thereby reduced.

Operational methods to improve street capacity include:

1. Control of access: A roadway with complete access control can often carry three times the traffic handled by a non-controlled-access street with identical lane width and number;

2. Parking removal: This increases capacity by providing additional street width for traffic flow and by reducing friction to such flow caused by parking and unparking vehicles;

3. One-way operation: Initiating one-way traffic operations can increase the capacity of a street by 20 to 50 percent depending upon turning movements and overall street width. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and by simplifying traffic signal coordination;

4. Reversible lanes: These lanes may be used to increase street capacity in situations where heavy directional traffic flows occur during peak periods;

5. Signal phasing and coordination: Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operations.

Altering travel demand is a third method to improve the efficiency of the existing street system. Travel demand can be reduced or altered in the following ways:

1. Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people-carrying capability of the street system;

2. Encourage the use of public transit and bicycles;

3. Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. This will reduce the travel demand during peak periods and spread it over a longer time frame;

4. Encourage planning for the use or redevelopment of land in a more travel efficient manner.

SYSTEM EFFICIENCY

The development of a more efficient street system to better serve travel desires is another means for altering travel demand. A more efficient system can reduce travel distances, times, and costs. Improvements in system efficiency can be achieved through the concept of functional classification of streets and through development of a coordinated major street system.

FUNCTIONAL CLASSIFICATION

Streets perform two primary functions--traffic service and land service, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts compounded by uncontrolled and intensely used abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets which permits travel from origins to destinations with directness, ease, and safety. Different streets in the system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict. Streets are categorized as to function as local access streets, minor thoroughfares, or major thoroughfares.

Local access streets provide access to abutting property. They are not intended to carry heavy volumes of traffic and should be located such that only traffic with origins and destinations on the streets would be served. Local streets may be further classified as either residential, commercial, or industrial depending upon the type of land use which they serve.

Minor thoroughfares are more important streets in the city system. They collect traffic from local access streets and carry it to the major thoroughfare system. They may in some instances supplement the major thoroughfare system by facilitating minor

through traffic movements. A third function which may be performed is that of providing access to abutting property. They should be designed to serve limited areas so that their development as major thoroughfares will be prevented.

Major thoroughfares are the primary traffic arteries of the city. Their function is to move intra-city and intercity traffic. The streets which comprise the major thoroughfare system may also serve abutting property, however, their major function is to carry traffic. They should not be bordered by uncontrolled strip development because such development significantly lowers the capacity of the thoroughfare to carry traffic, and each driveway is a danger and an impediment to traffic flow. Major thoroughfares may range from a two-lane street carrying minor traffic volumes to major expressways with four or more traffic lanes. Parking normally should not be permitted on major thoroughfares.

IDEALIZED MAJOR THOROUGHFARE SYSTEM

A coordinated system of major thoroughfares forms the basic framework of the urban street system. A major thoroughfare system which is most adaptable to desired lines of travel within an urban area and which permits movement between various areas of the city with maximum directness is the radial-loop system. This system consists of several elements: radial streets, crosstown streets, loop streets, and bypasses. Figure 1 shows this system.

Radial streets provide for traffic movement between points located in the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. A system of crosstown streets which forms a loop around the central business district is needed to avoid this problem. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the areas's border and allows central area traffic to circle and then enter the area near the appropriate destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function better in its role as a pedestrian shopping area.

Loop streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may go from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve it in central areas. One or more loops may exist, depending upon the size of the urban area, and they should be spaced one

IDEALIZED THOROUGHFARE PLAN

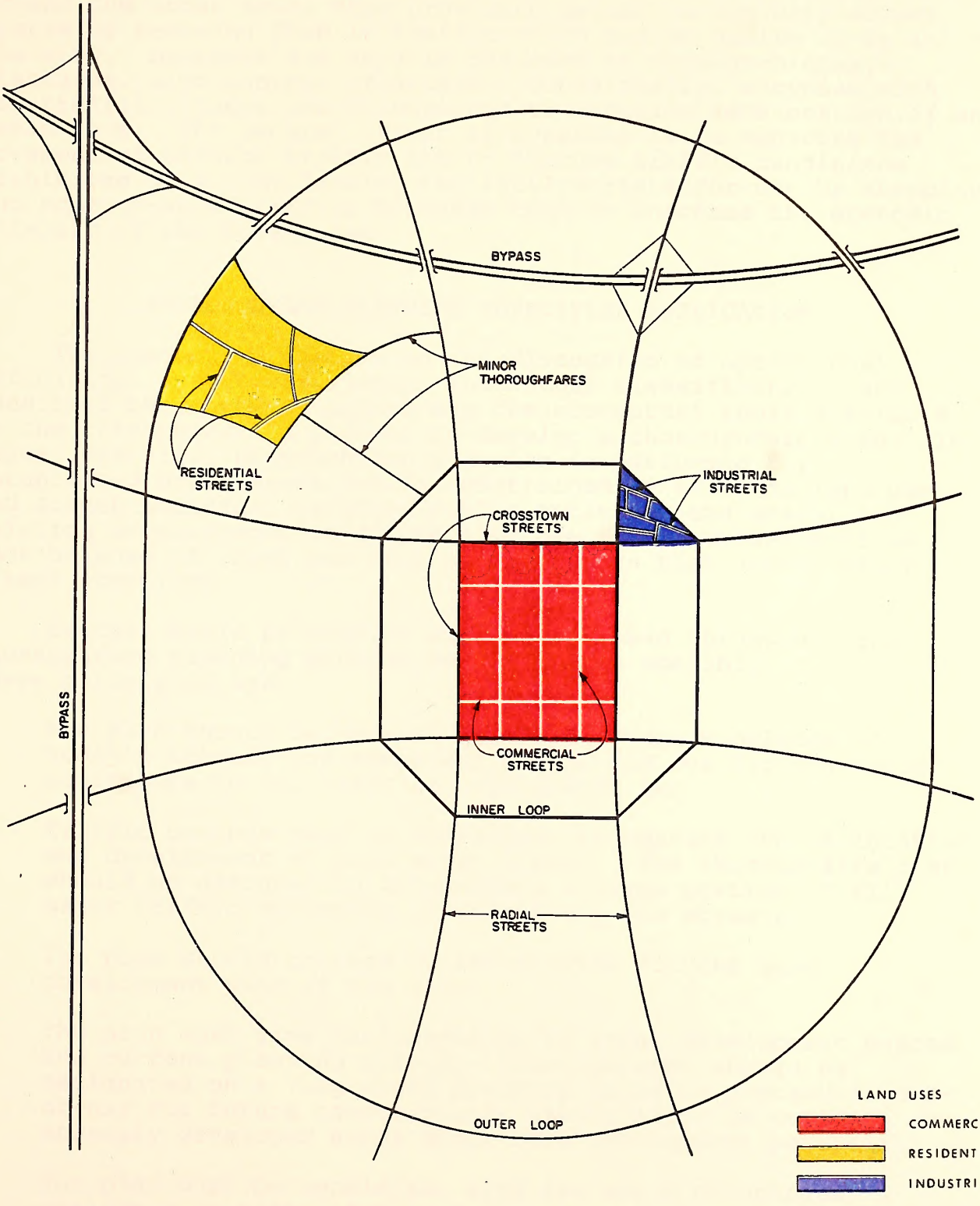


FIGURE 1

half-mile to one mile apart, depending upon the intensity of land use.

A bypass is generally designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing from it traffic which has no desire to be in the city. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volumes can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

THOROUGHFARE PLANNING PRINCIPLES APPLICATION

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized thoroughfare system are the conceptual tools available to the transportation planner to develop a thoroughfare plan. In actual practice, thoroughfare planning is performed for established urban areas and is constrained by existing land use and street patterns, existing public attitudes and goals, and existing expectations of future land use. Compromises must be made because of these and many other factors that affect major street locations.

Certain basic principles must be followed throughout the thoroughfare planning process as closely as possible. These principles are:

1. The plan should be derived from a thorough knowledge of today's travel, its component parts, and the factors which contribute to it, limit it, and modify it;

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of all major traffic movements on relatively few streets;

3. The plan should conform to and provide for the land development plan of the area;

4. The plan must give consideration to urban development beyond the current planning period. Thoroughfares should be designated on a long-range planning basis to protect rights-of-way for future construction, particularly in outlying or sparsely developed areas which have development potential;

5. The plan must be consistent with the above principles, realistic in terms of travel trends, and economically feasible.

The basic concept of an idealized thoroughfare system has been outlined previously. Many factors influence the final location, design, and designation of streets on a thoroughfare system. One of the most important factors is the anticipated future traffic demand. In addition to this factor, others which influence the final design include:

1. Location of existing and anticipated major traffic generators such as shopping centers, central business districts, and larger industrial plants;

2. Existing residential patterns, schools, churches, cemeteries, and other social and recreational areas;

3. Topography and hydrology;

4. Location and design of existing highways and streets;

5. Level-of-service to be maintained on the street system;

6. Existing right-of-way and development adjacent to the present street system;

7. Anticipated future land use (this is important since the thoroughfare system will exert a major influence on future land development);

8. Anticipated availability of funds in establishing priorities for future improvements;

9. Environmental impacts of the thoroughfare system and its related highway construction;

10. Availability or anticipated development of other transportation modes, such as public transit, which could serve local travel desires.

PLANNING CONSIDERATIONS

MAJOR ROUTES

I-95 provides Four Oaks with its primary access north and south to Smithfield and Fayetteville, and US301 runs parallel to I-95 supplementing north-south access and serves the commercial areas along its route. NC96 provides access to other parts of Johnston County.

POPULATION TRENDS

Travel demand is directly related to the an area's population, although in Four Oaks a significant amount of travel originates outsides its immediate area. Table 1 shows the population trends for the Four Oaks area.

TABLE 1
FOUR OAKS POPULATION DATA AND PROJECTIONS

YEAR	NORTH CAROLINA	JOHNSTON COUNTY	INGRAMS TOWNSHIP	FOUR OAKS TOWN
1910	2,206,287	41,401	2,862	329
1920	2,559,123	48,998	3,480	583
1930	3,170,276	57,621	4,220	684
1940	3,571,623	63,798	4,390	828
1950	4,061,929	65,906	4,447	942
1960	4,556,155	62,936	4,100	1,010
1970	5,084,411	61,737	3,838	1,057
1980	5,881,766	70,599	4,615	1,049
1990	6,628,637	81,306	5,063	1,308
2000	7,260,748a	93,431a	5,750b	1,540b
2010	7,775,979a	103,063a	6,270b	1,780b

1910-1990 statistics from the United States Bureau of the Census
a = Estimate made by the North Carolina Office of State Budget and Management
b = Estimate made by North Carolina Department of Transportation based on the historical relationship to Johnston County growth.

Four Oaks experienced significant growth between 1980 and 1990, and historically it has experienced somewhat more than Johnston County as a whole. Municipal growth projections are difficult at best because of unknown future annexations. Townships do not change boundaries and therefore provide better limits for analysis. The population of Ingrams Township has grown at an annualized rate of 0.3% from 1950 to 1990, compared to 0.5% for Johnston County during the same period.

ECONOMY AND EMPLOYMENT

Like many smaller municipalities in North Carolina, Four Oaks' employment has been based on agriculture. Principal products include tobacco, corn, and soybeans. Animal husbandry is also significant.

Many of the residents of Four Oaks commute to jobs in Smithfield and Raleigh; the recent completion of I-40 has improved access to the Triangle area. Much of Four Oaks is residential in nature.

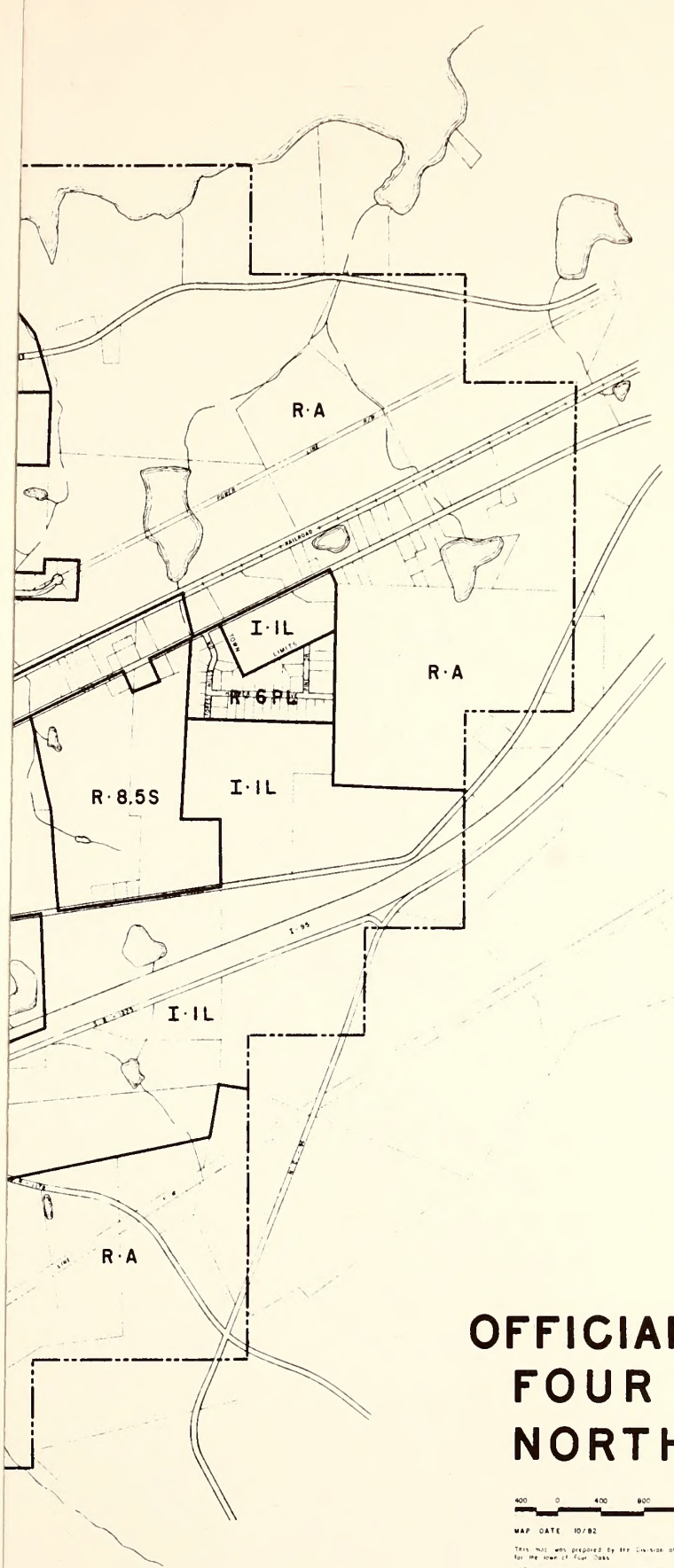
Figure 2 shows Four Oaks' Official Zoning Map. The zoning map indicates light industrial areas along I-95 and Wellons Street (US301) and business areas along Wellons Street (US301) and Main Street (SR1162). The map indicates the remaining areas around Four Oaks to be some variety of residential use. The Planning Board envisioned that future residential growth would occur primarily in the area northwest to northeast of Four Oaks.

TRAVEL DEMAND

Average Daily Traffic (ADT) counts give the travel demand upon a given facility. The North Carolina Department of Transportation has taken counts on a continuing basis at several locations in and around Four Oaks.

Travel demand grew between 1.0% to 3.9% (2.4% average) on an annualized basis on various roadways throughout Four Oaks from 1970 to 1990. The largest growth percentages occurred on the Interstate Highway (I-95) and some sections of Wellons Street (US301). Figure 3 shows 1990 base year traffic volumes and 2010 design year traffic projections at various locations in Four Oaks. This data is also displayed in tabular form in Appendix B.

Initial traffic projections were developed from trend analysis based on traffic volume data from 1960 through 1990. The Planning Board provided input on anticipated future growth, and this information was used to modify the initial projections to prepare projections more reflective of recent and near-term future developments.



OFFICIAL ZONING MAP
FOUR OAKS
NORTH CAROLINA

400 0 400 800 1200 1600 ft

MAP DATE 10/82

This map was prepared by the Division of Community Assistance, for the town of Four Oaks

NOTE Property lines are approximate and should not be used for tax purposes

THIS IS TO CERTIFY THAT THIS IS THE OFFICIAL ZONING MAP OF THE TOWN OF FOUR OAKS, NORTH CAROLINA

THIS MAP ADOPTED 9/6/89 BY THE FOUR OAKS TOWN BOARD OF COMMISSIONERS, SHALL TAKE EFFECT AND BE IN FORCE FROM AND AFTER 9/6/89

MAYOR

ATTEST

Town Clerk

FIGURE 2

Four Oaks experienced significant growth between 1980 and 1990, and historically it has experienced somewhat more than Johnston County as a whole. Municipal growth projections are difficult at best because of unknown future annexations. Townships do not change boundaries and therefore provide better limits for analysis. The population of Ingrams Township has grown at an annualized rate of 0.3% from 1950 to 1990, compared to 0.5% for Johnston County during the same period.

ECONOMY AND EMPLOYMENT

Like many smaller municipalities in North Carolina, Four Oaks' employment has been based on agriculture. Principal products include tobacco, corn, and soybeans. Animal husbandry is also significant.

Many of the residents of Four Oaks commute to jobs in Smithfield and Raleigh; the recent completion of I-40 has improved access to the Triangle area. Much of Four Oaks is residential in nature.

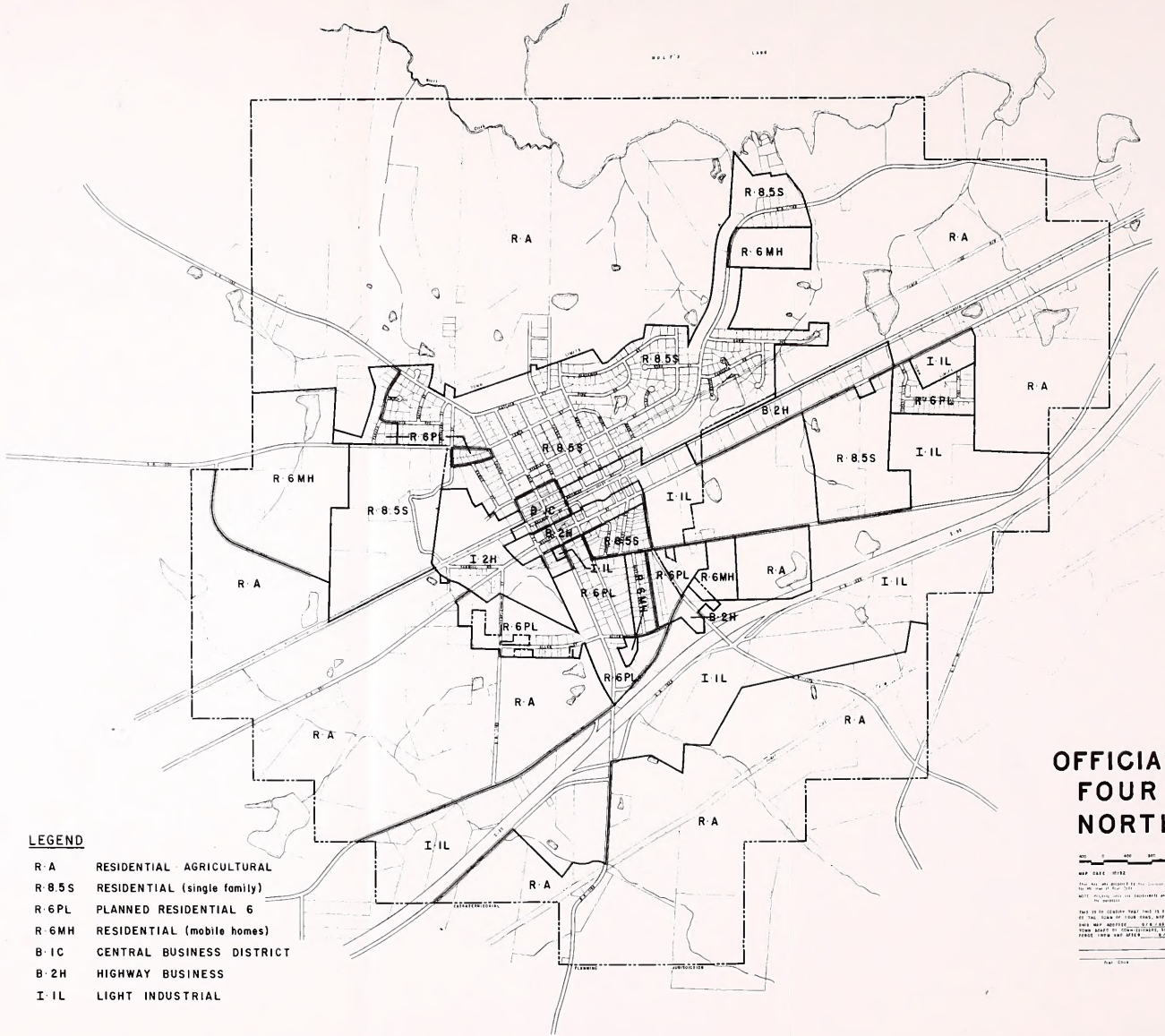
Figure 2 shows Four Oaks' Official Zoning Map. The zoning map indicates light industrial areas along I-95 and Wellons Street (US301) and business areas along Wellons Street (US301) and Main Street (SR1162). The map indicates the remaining areas around Four Oaks to be some variety of residential use. The Planning Board envisioned that future residential growth would occur primarily in the area northwest to northeast of Four Oaks.

TRAVEL DEMAND

Average Daily Traffic (ADT) counts give the travel demand upon a given facility. The North Carolina Department of Transportation has taken counts on a continuing basis at several locations in and around Four Oaks.

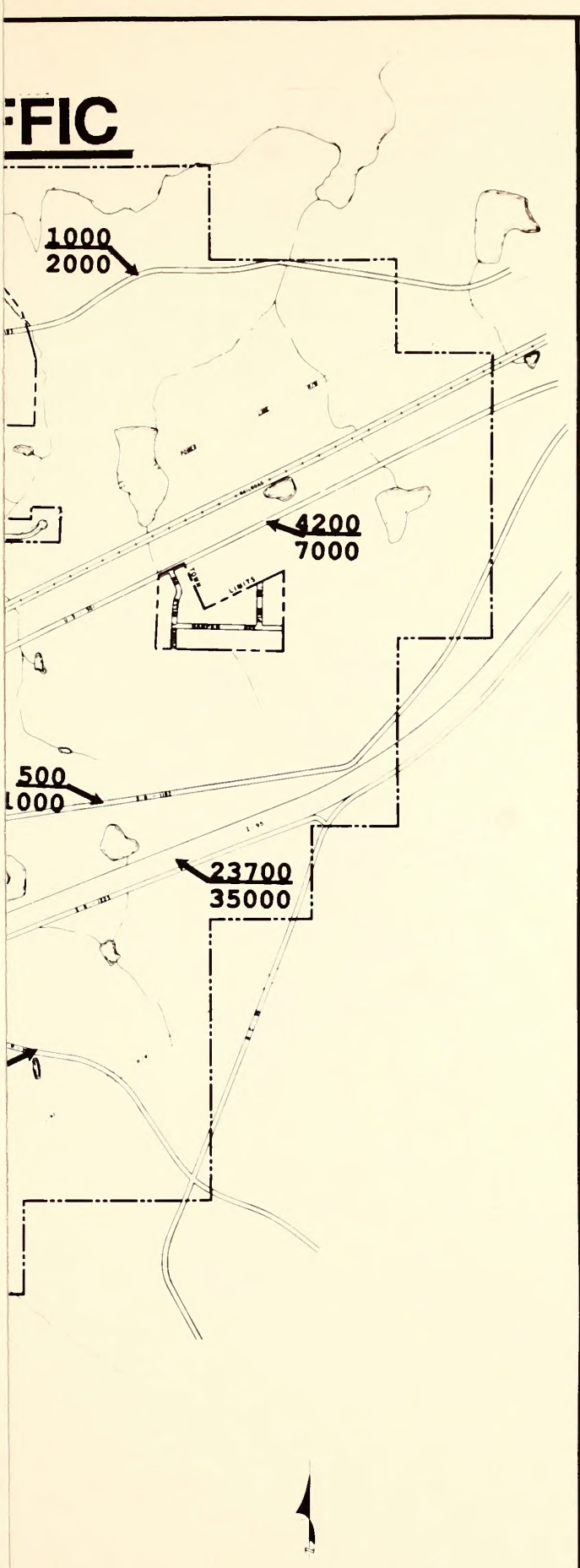
Travel demand grew between 1.0% to 3.9% (2.4% average) on an annualized basis on various roadways throughout Four Oaks from 1970 to 1990. The largest growth percentages occurred on the Interstate Highway (I-95) and some sections of Wellons Street (US301). Figure 3 shows 1990 base year traffic volumes and 2010 design year traffic projections at various locations in Four Oaks. This data is also displayed in tabular form in Appendix B.

Initial traffic projections were developed from trend analysis based on traffic volume data from 1960 through 1990. The Planning Board provided input on anticipated future growth, and this information was used to modify the initial projections to prepare projections more reflective of recent and near-term future developments.



OFFICIAL ZONING MAP
FOUR OAKS
NORTH CAROLINA

FIGURE 2



FOUR OAKS
TRAFFIC VOLUMES

1990 BASE YEAR
2010 DESIGN YEAR

FOUR OAKS
JOHNSTON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS-PLANNING AND ENVIRONMENTAL BRANCH

IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

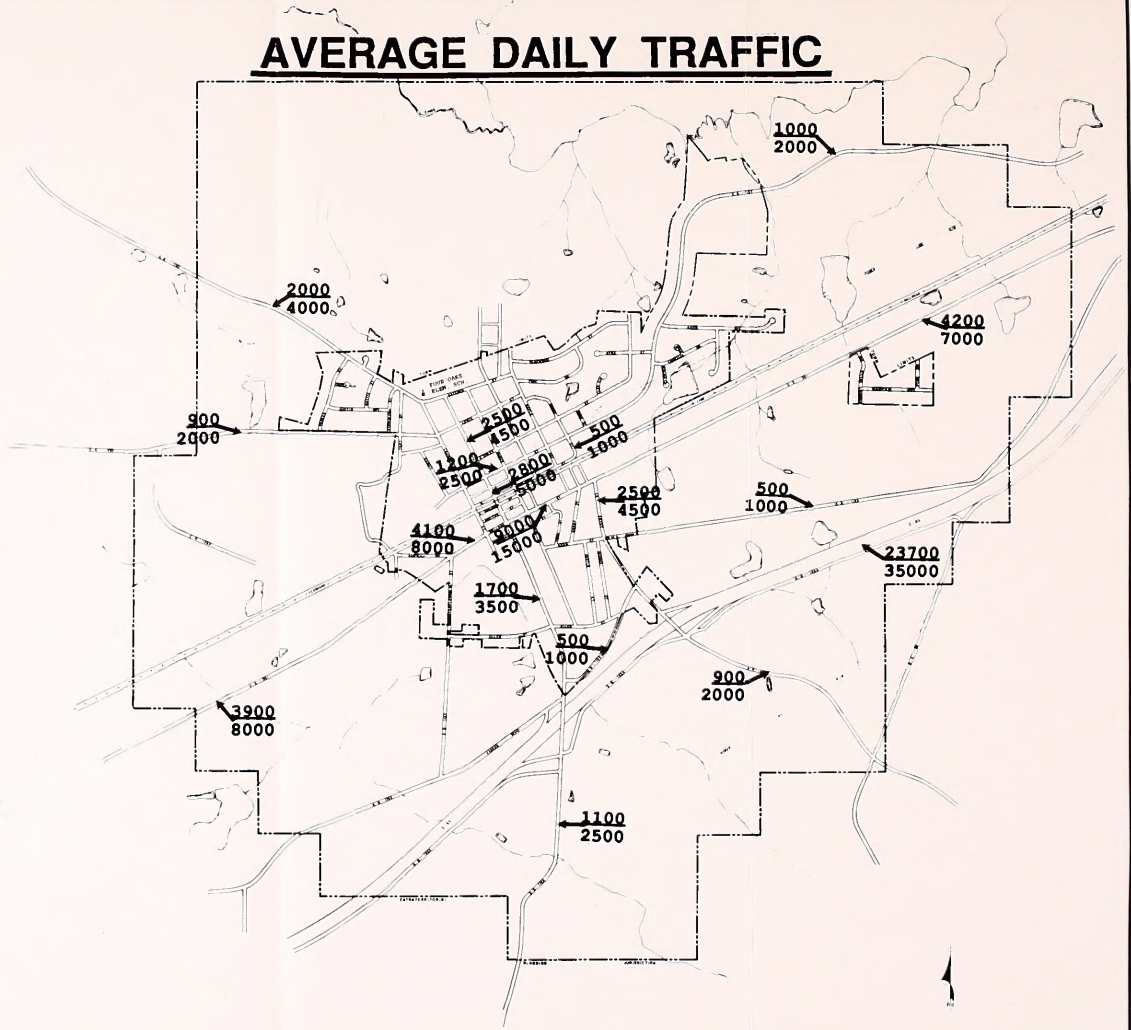
FIGURE 3

0 800 1600 2400 3200

SCALE IN FEET

JULY 11, 1991

AVERAGE DAILY TRAFFIC



FOUR OAKS TRAFFIC VOLUMES

1990 BASE YEAR

2010 DESIGN YEAR

FOUR OAKS

JOHNSTON COUNTY

NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS-PLANNING AND ENVIRONMENTAL BRANCH

IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

FIGURE 3

0 800 1600 2400 3200

SCALE IN FEET

JULY 11, 1991

TRAFFIC ACCIDENTS

Traffic accidents are an important concern in thoroughfare planning. The sources of traffic accidents are broken down into three general categories. The first category is the physical environment which includes road conditions, weather, obstructions, and traffic conditions. The second category is driver factors which include mental alertness, distractions, vehicle handling ability, and reaction time. The third category is the vehicle factors which include brake and tire conditions, responsiveness, size, and operation of other safety features. Traffic accidents can be attributed to one or more of these sources; normally the driver is the primary source.

Table 2 shows accident data for the period January 1986 through December 1990.

TABLE 2
FOUR OAKS 1986-1990 TRAFFIC ACCIDENT SUMMARY

LOCATION	NUMBER
Adams Street (SR1178) at Wellons Street (US301)	8
Main Street (SR1162) at Railroad Street	5
Main Street (SR1162) at Sanders Street (SR1183)	5

CAPACITY ANALYSIS

A comparison of traffic volumes with the ability of the streets to move traffic freely at a desirable speed gives a good indication of the adequacy of the existing major street system. The ability of a street to process traffic freely, safely, and efficiently with a minimum of delay is controlled primarily by the spacing of the major devices utilized. Therefore, the ability of a street to process traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and application of other traffic engineering techniques.

"In general, the capacity of a facility is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions." [Transportation Research Board, Highway Capacity Manual, Special Report 209, 1985, page 1-3] The relationship of the traffic volumes to the capacity of the roadway determines the level-of-service provided. The Highway Capacity Manual defines six levels of service to identify the conditions existing under various speed and volume combinations on a roadway.

1. Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

2. Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

3. Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

4. Level-of-service D represents high-density, but stable flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

5. Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuvers. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

6. Level-of-service F is used to define forced flow or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable

TRAFFIC ACCIDENTS

Traffic accidents are an important concern in thoroughfare planning. The sources of traffic accidents are broken down into three general categories. The first category is the physical environment which includes road conditions, weather, obstructions, and traffic conditions. The second category is driver factors which include mental alertness, distractions, vehicle handling ability, and reaction time. The third category is the vehicle factors which include brake and tire conditions, responsiveness, size, and operation of other safety features. Traffic accidents can be attributed to one or more of these sources; normally the driver is the primary source.

Table 2 shows accident data for the period January 1986 through December 1990.

TABLE 2
FOUR OAKS 1986-1990 TRAFFIC ACCIDENT SUMMARY

LOCATION	NUMBER
Adams Street (SR1178) at Wellons Street (US301)	8
Main Street (SR1162) at Railroad Street	5
Main Street (SR1162) at Sanders Street (SR1183)	5

CAPACITY ANALYSIS

A comparison of traffic volumes with the ability of the streets to move traffic freely at a desirable speed gives a good indication of the adequacy of the existing major street system. The ability of a street to process traffic freely, safely, and efficiently with a minimum of delay is controlled primarily by the spacing of the major devices utilized. Therefore, the ability of a street to process traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and application of other traffic engineering techniques.

"In general, the capacity of a facility is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions." [Transportation Research Board, Highway Capacity Manual, Special Report 209, 1985, page 1-3] The relationship of the traffic volumes to the capacity of the roadway determines the level-of-service provided. The Highway Capacity Manual defines six levels of service to identify the conditions existing under various speed and volume combinations on a roadway.

1. Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

2. Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

3. Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

4. Level-of-service D represents high-density, but stable flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

5. Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuvers. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

6. Level-of-service F is used to define forced flow or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable

> speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of vehicles or pedestrians discharges from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

Figure 4 shows the six levels of service defined above. "These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them. Each chapter of the manual contains more detailed descriptions of the levels of service as defined for each facility type." [Highway Capacity Manual, page 1-4]

The analysis of the existing roadways and recommendations for improvements are based on achieving a minimum of Level-of-service D. LOS D is often considered the "practical capacity" of a facility or that at which the public begins to express dissatisfaction.

ENVIRONMENTAL AND SOCIAL FACTORS

Various environmental and social factors affect thoroughfare planning. The thoroughfare plan seeks to improve existing facilities and develop new facilities with a minimum of disruption to social, cultural, recreational, commercial, biological, and aesthetic attributes of the community.

A review of the information at the North Carolina Department of Cultural Resources, Division of Archives and History, revealed no sites on the National Register And State Study List in the Four Oaks area. The probability of disturbing any areas of historical or archaeological significance is low.

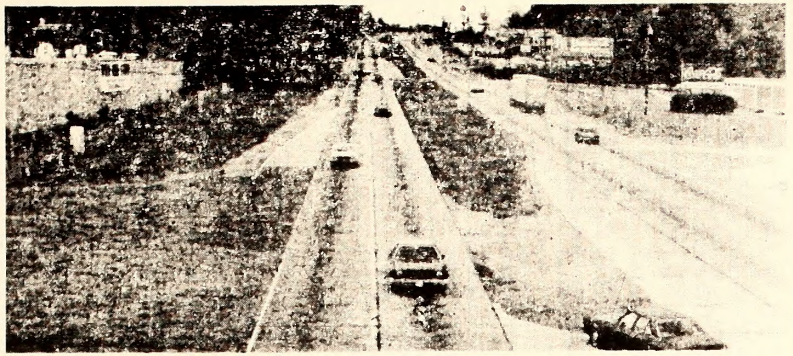
A review of the information at the North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, revealed only one site with a species on the State "threatened" species list. This site is on Black Creek which ultimately empties into Holt Lake, north of Four Oaks. The Atlantic Pigtoe (fusconaia masoni), a freshwater bivalve was found in Black Creek at one time.

A review of the National Wetlands Inventory mapping ("Four Oaks, N.C." 7 August 1989) prepared by the United States Department of the Interior, Fish and Wildlife Service, indicated that only two minor wetlands streams would be crossed at right angles by the proposed Western Loop Road. The thoroughfare plan

would have minimal impacts on any wetlands in the area. No other significant adverse impacts upon environmental values in Four Oaks were identified during this study.

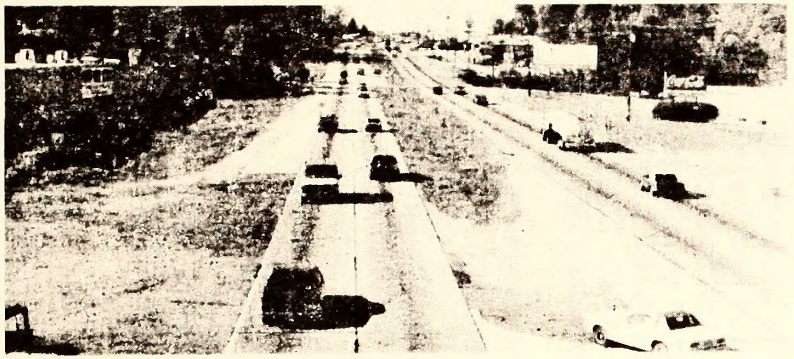
No business or commercial structures appear to be subject to dislocation by the proposed projects on the adopted plan. However, some residential structures may be impacted. The Allendale Road (SR1164) extension from Adams Street (SR1178) to Keen Street (SR1182) could possibly miss the several residential structures at the ends of the project, but it almost certainly would dislocate several mobile homes in the mobile home park adjacent to Keen Street. The Moore Street extension would probably dislocate two structures near Wellons Street (US301) opposite Adams Street. The Western Loop would probably not dislocate any residences if it were built today, with the possible exception of the intersection point with SR1162. However, the Town of Four Oaks must protect this corridor to prevent adverse impacts to residential developments that may occur in this area in the future.

None of the proposed projects appear to adversely affect any churches, schools, parks, or other community facilities. The Western Loop, due to its length and course through undeveloped areas may encounter some isolated cemeteries, but it is not likely to have any major impacts. The Western Loop passes well south of the wetlands adjacent to Holt Lake.

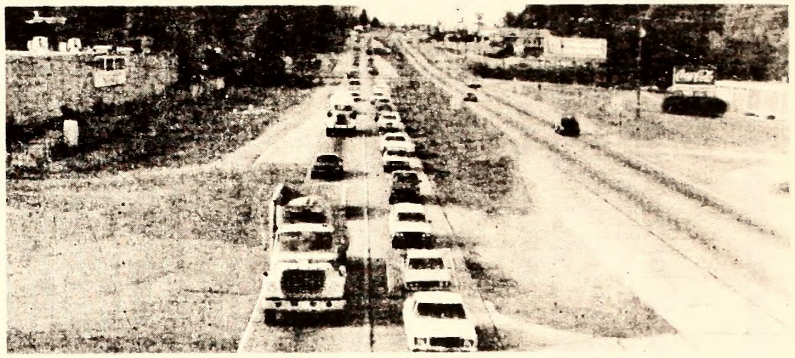


LEVEL OF SERVICE - A

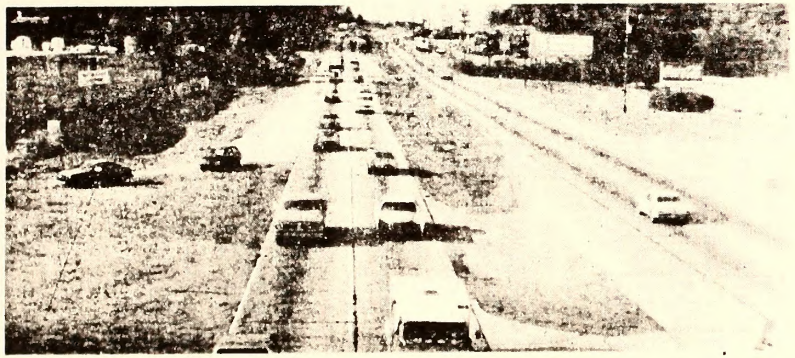
LEVEL OF SERVICE - D



LEVEL OF SERVICE - B



LEVEL OF SERVICE - E



LEVEL OF SERVICE - C

LEVEL OF SERVICE - F

LEVELS OF SERVICE

FIGURE 4

RECOMMENDATIONS

The thoroughfare plan designates roadways that serve as major and minor thoroughfares in accordance with the principles of Chapter 2. The following sections discuss the various thoroughfares and their relevant features. Appendix B provides additional information on these routes.

Many of the thoroughfares in the area consist of two-lane roadways with pavements widths less than twenty-four feet (twelve-foot lanes). Widening them to twenty-four feet in width is highly desirable in terms of increasing safety and operational efficiency and decreasing maintenance costs.

MAJOR THOROUGHFARES

Interstate Highway I-95: This fully-controlled access roadway is part of the National System of Interstate and Defense Highways. While it has significant residual capacity, it will be improved in coming years, to rehabilitate its pavement and to correct deficiencies dating to the time of its incorporation to the Interstate System.

Wellons Street (US301): Wellons Street serves as the primary commercial axis of Four Oaks. It carries both through traffic and internal traffic and served as the main north-south route through Johnston county prior to the construction of I-95. Future traffic growth should be adequately served by this existing three-lane roadway, although without much additional capacity to spare. The Church Street to Adams Street section currently functions with one through lane in each direction and with one continuous center turn lane. Unanticipated growth in Four Oaks could lead to the need for additional capacity in this particular area.

Adams Street (SR1178): This roadway should be widened to twelve-foot lanes but is otherwise adequate for anticipated future traffic. It shares a split diamond interchange on I-95 with Main Street (SR1162); some modifications to the interchange may be initiated in the future, such as removal of its ramps to allow for the creation of a full diamond interchange at SR1162.

Hatcher Street (SR1162): The basic cross section of this roadway is adequate, but it should receive paved shoulders and wider lanes, particularly in view of the traffic it brings into the Four Oaks Elementary School and the Middle School and of the commuter traffic that uses this route to travel towards Smithfield and Raleigh.

Main Street (SR1162): Main Street connects Four Oaks directly to I-95 and serves the commercial areas along its length through the Central Business District. It is currently being widened and outfitted with curb-and-gutter north of Allen Street.

The current interchange with I-95 is a split diamond (with Adams Street) and allows ramp traffic and service road traffic to mix. Modification of this interchange has been scheduled in the Transportation Improvement Program as Project I-2704.

MINOR THOROUGHFARES

The thoroughfare plan designates several existing minor thoroughfares which should not experience capacity problems through the design year and do not need any major improvements other than widening to twelve-foot lanes. These include Keen Street (SR1182), Lewis Street (SR1350), and Sanders Street (SR1183).

Some minor thoroughfares should be extended to improve local access. Allendale Road (SR1164) should be extended to Keen Street east of Adams Street. Moore Street should be shifted slightly so that its intersection with Maple Avenue lines up opposite Lewis Street. It should also be extended across the CSX Railroad track to intersect Wellons Street opposite Adams Street to provide a fourth crossing of the track for Four Oaks residents; this would provide better mobility for fire and rescue vehicles based south of the track to reach the residential areas north of it.

The proposed Western Loop Road is the only totally new minor thoroughfare. It will utilize some of the alignment of the existing (but unpaved) SR1364, and it will serve the proposed industrial park in this vicinity as well as future residential growth on the north side of Four Oaks. It will also provide a fifth crossing of the CSX Railroad track; a grade separation would be preferable due to the heavy usage of the track (24 trains per day in 1991), but funding constraints and proximity to US301 will make this difficult.

CONSTRUCTION IMPROVEMENTS AND COST ESTIMATES

Construction priorities vary depending upon the criteria used and weights assigned to them. Improvements to major thoroughfares generally outweigh improvements to minor thoroughfares with lower volumes of traffic. Projects must show favorable benefit to cost ratios for inclusion in the TIP. Table 3 shows construction cost estimates, benefits, and impacts for proposed projects on the thoroughfare plan.

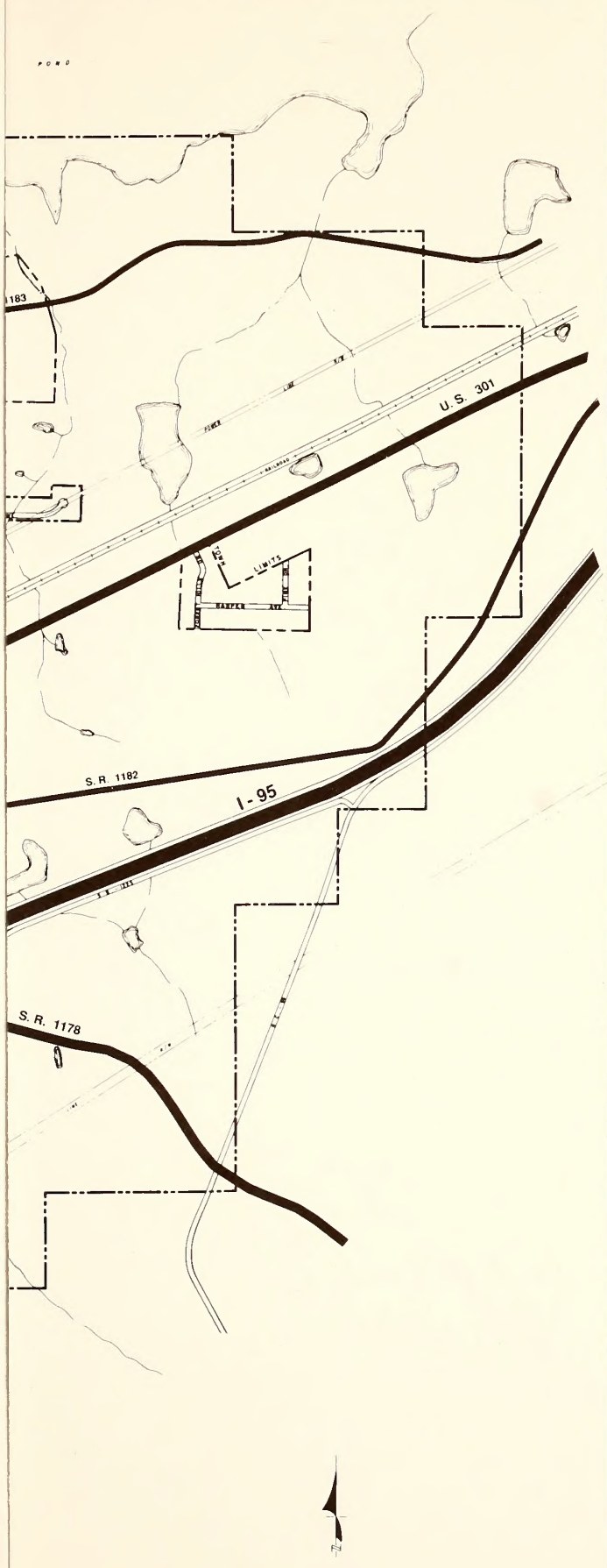
TABLE 3
FOUR OAKS BENEFITS, COSTS, AND IMPACTS ESTIMATES

PROJECT	BENEFITS dollars	COSTS dollars	ECONOM IMPACT	ENVIRO IMPACT
Allendale Road Ex (0.2 miles)	295,000	R 57,000 C 28,000	+.25	+.25 -.25
Moore Street Ext (0.1 miles)	1,283,000	R 53,000 C 11,000	+.25	+.50 -.25
Western Loop Road (3.5 miles)	53,328,000	R 363,000 C 1,505,000	+.50	+.25 -.50

1. Benefits to be gained over a 20-year period.
2. Costs are for right-of-way (R) and construction (C).
3. Positive environmental impacts on a scale from 0.00 to +1.00.
4. Negative environmental impacts on a scale from -1.00 to 0.00.
5. Reference: North Carolina Department of Transportation, Transportation Project Evaluation Using The Benefits Matrix Model, Technical Report 8, 1983; and NCDOT, Benefits Matrix Model Cost Update, Second Supplement To Technical Report 8, 1988.

Figure 5 shows the Four Oaks Thoroughfare Plan of 12 August 1991 as adopted by the Four Oaks Board of Commissioners on 9 September 1991 and by the North Carolina Board of Transportation on 11 October 1991.

THIS PAGE INTENTIONALLY LEFT BLANK



LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE		
FREEWAYS	▬▬▬	▬ ▬ ▬
OTHER	▬▬▬	▬ ▬ ▬
MINOR THOROUGHFARE	———	- - -

ADOPTED BY:

TOWN OF FOUR OAKS SEPTEMBER 9, 1991

PLANNING AND ENVIRONMENTAL BRANCH SEPTEMBER 16, 1991

N.C. DEPARTMENT OF TRANSPORTATION OCTOBER 11, 1991

PUBLIC HEARING DATE SEPTEMBER 9, 1991

REVISIONS

TOWN OF FOUR OAKS	PLANNING AND ENVIRONMENTAL	N.C. DEPARTMENT OF TRANSPORTATION

THOROUGHFARE PLAN
FOUR OAKS
JOHNSTON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS-PLANNING AND ENVIRONMENTAL BRANCH

IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

AUGUST 12, 1991

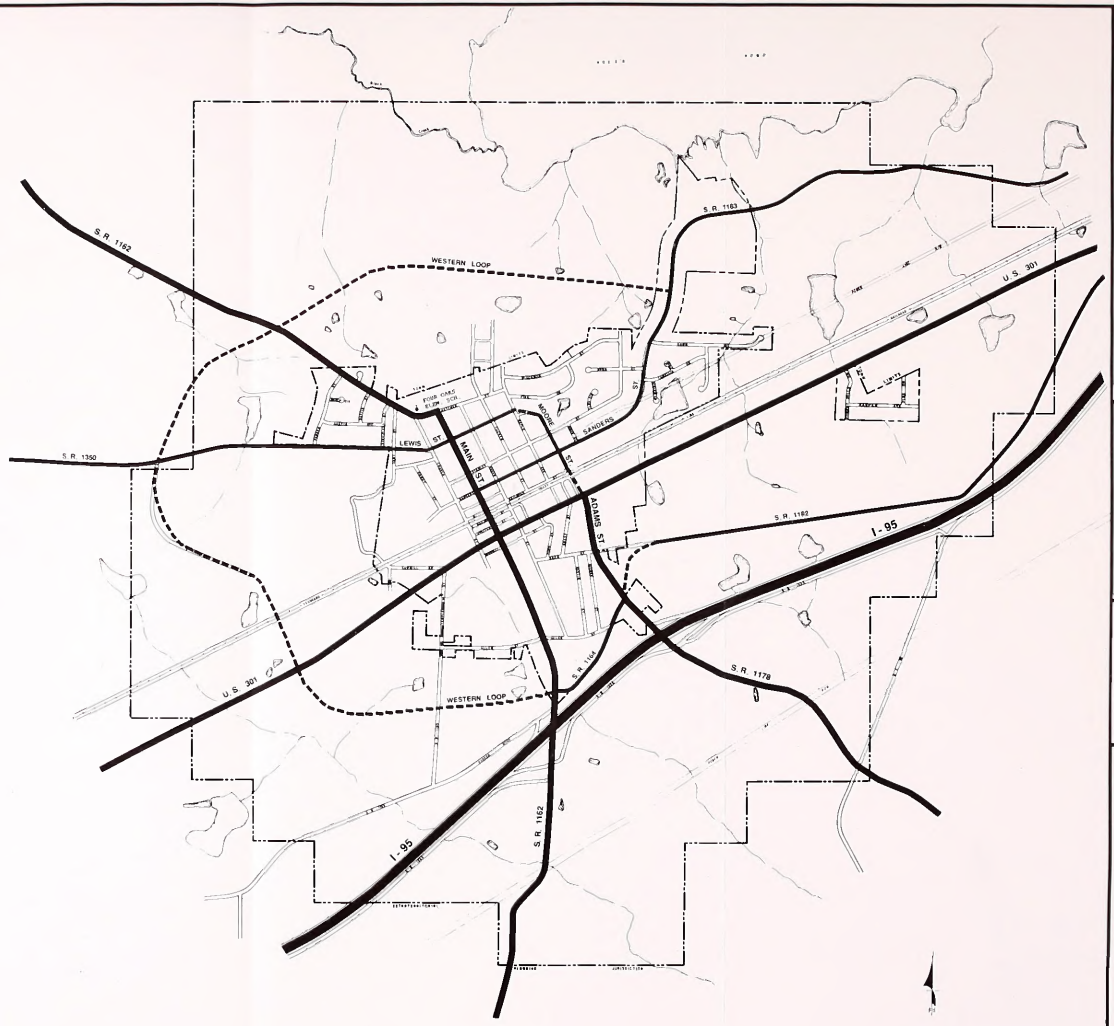
FIGURE 5

0 800 1600 2400 3200

SCALE IN FEET

JULY 11, 1991

THIS PAGE INTENTIONALLY LEFT BLANK



LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE		
FREEWAYS	▬▬	▬ ▬ ▬
OTHER	▬▬	▬ ▬ ▬
MINOR THOROUGHFARE	———	- - -

ADOPTED BY:

TOWN OF FOUR OAKS SEPTEMBER 9, 1991

PLANNING AND ENVIRONMENTAL BRANCH SEPTEMBER 16, 1991

N.C. DEPARTMENT OF TRANSPORTATION OCTOBER 11, 1991

PUBLIC HEARING DATE SEPTEMBER 9, 1991

REVISIONS

TOWN OF FOUR OAKS	PLANNING AND ENVIRONMENTAL	N.C. DEPARTMENT OF TRANSPORTATION

THOROUGHFARE PLAN
FOUR OAKS
JOHNSTON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS-PLANNING AND ENVIRONMENTAL BRANCH

IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

AUGUST 12, 1991

FIGURE 5

0 800 1600 2400 3200

SCALE IN FEET

JULY 11, 1991

IMPLEMENTATION

The Town of Four Oaks and the State of North Carolina have joint responsibility for the implementation of the Four Oaks Thoroughfare Plan. North Carolina General Statute 136-66.1 specifies which elements of a plan are a State responsibility and which are a Town responsibility. In general, the State is responsible for those facilities which will serve major volumes of through traffic and external traffic proceeding inward to major commercial, industrial, and institutional areas within the municipality. The Town is responsible for those facilities which serve primarily internal travel. The Town will share a portion of the right-of-way cost on projects constructed by the State depending upon the degree of benefits to the municipality.

The recommended construction improvements in the Four Oaks Thoroughfare Plan total $2.017 million. Declining gasoline tax revenues and increasing road construction costs have greatly reduced the ability of the State to fund improvements. North Carolina's highway needs for the years 1990 through 2000 total approximately $16 billion [NCDOT, Transportation Improvement Program 1991-1997, December 1990, page HP-1]. Transportation needs far outweigh the available funding. The State and the federal government are relying increasingly on municipal and private funding.

Initiative for plan implementation rests largely with the Town of Four Oaks. Implementation of the plan will not be easy. The Town may use a number of procedures, resources, and tools to aid in plan implementation. These include town funding, federal revenue sharing or block grants, urban bonds, urban redevelopment programs, municipal service districts, zoning ordinances, subdivision ordinances, future street line ordinances, advance purchase of right-of-way, and lobbying for State construction of needed facilities which are State responsibility. Effective and continuing use of available resources, tools, and programs over an extended period of time will result in the recommended projects being developed.

A number of the administrative tools and procedures recommended for project implementation may be appropriate for Four Oaks. Many of these may be used effectively to make improvements to other elements of the street system which would be desirable but which are not identified as specific needs. A discussion of these tools and procedures is given below.

SUBDIVISION CONTROL

A subdivision ordinance requires that every developer submit a plat of his proposed subdivision to the Planning Board for review and approval. Certain standards must be met by the developer before he can receive a permission to construct his

development. Through this process, the necessary right-of-way for streets which are part of the thoroughfare plan may be obtained or protected from development. Street construction in accordance with the plan can be required of the developer.

Appendix A gives recommended definitions and design standards for subdivision ordinances. Four Oaks currently has extraterritorial jurisdiction for zoning and planning. A review of Four Oaks' present ordinances to insure that they are compatible with the thoroughfare plan is desirable.

OFFICIAL STREET MAP

A municipality may, through special enabling legislation, adopt an official street map which indicates both existing and future street lines. No new construction or reconstruction of structures is permitted within the designated future street lines. This has over a period of time reduced the cost of additional right-of-way along densely developed thoroughfares which have required widening.

House Bill 1211 enables Four Oaks to protect and acquire right-of-way outside its corporate limits for street or sidewalk construction since this thoroughfare plan has been mutually adopted by the Town of Four Oaks and the State of North Carolina. If Four Oaks funds acquisition of right-of-way for a State highway system street improvement project, the North Carolina Department of Transportation may reimburse the Town in whole or in part for expenditures made by the Town to acquire or fund the acquisition of right-of-way.

FUTURE STREET LINE ORDINANCE

This ordinance is of particular benefit were widening of a street will be necessary at some time in the future. A municipality, with legislative approval, may amend its charter to be empowered to adopt future street line ordinances. Through a metes-and-bounds description of a street's future right-of-way requirements, the Town may prohibit new construction or reconstruction of existing structures within the future right-of-way. This approach requires a specific design for the facility and normally requires property surveys and public hearings to allow affected land owners to know what is proposed and to make appropriate adjustments without undue hardships. Recommended rights-of-way and cross sections for thoroughfares are shown in Appendix B.

ZONING

Zoning ordinances are beneficial to thoroughfare planning in that planned locations of various land uses and their densities

can be achieved. This provides some stability upon which to base travel forecasts and to plan street development.

Other benefits include the establishment of standards of development which will aid traffic operations on major thoroughfares, the minimization of strip commercial development which creates traffic friction and traffic accident potential, and the requirement of provision of off-street parking in new development with the intention of ultimately prohibiting all curb parking on major thoroughfares.

REDEVELOPMENT

Redevelopment is the term used to describe efforts toward the removal or rehabilitation of undesirable development. It is one of the few tools available to correct basic mistakes in the street system, such as poor design, poor layout, and too many streets.

MUNICIPAL SERVICE DISTRICTS

Under North Carolina General Statute, Chapter 160A, Sections 535-543, the legislative body of a municipality may create one or more municipal service districts in a downtown commercial area in order to raise additional funds for physical improvements. One purpose of the district could be to facilitate traffic flow and parking. The district may issue bonds which would be paid off with revenues from an extra ad valorem tax on all property within the district's boundaries. Once the improvements are completed and the bonds are retired, the extra taxation would cease and the district would be dissolved.

CAPITAL IMPROVEMENTS PROGRAM

Another tool for building the thoroughfare system is the capital improvements program. This is a long-range plan for spending money on street improvements, right-of-way acquisition, and other capital improvements, within the bounds of projected revenues. The Town will need funds for the construction of streets which are municipal responsibilities, for the sharing of costs of right-of-way of streets which are State responsibilities, and for the advance purchasing of right-of-way where appropriate.

Table 3 shows the cost estimates for the recommended projects. These estimates are preliminary and are based upon general statewide averages of construction costs. The final costs of projects may be significantly higher or lower. Right-of-way costs could be minimized by exercising the planning controls previously described and by selectively advance purchasing right-of-way as opportunities occur.

DEVELOPMENT REVIEWS

Requests for driveway access to state-maintained roadways are reviewed by the District Engineer's office of the North Carolina Department of Transportation prior approval being granted, as prescribed by North Carolina General Statute 136-93. Any development expected to generate large volumes of traffic, such as shopping centers, large industries, and so forth, may be comprehensively studied by a review team of staff personnel from Traffic Engineering Branch, Statewide Planning Branch, and Highway Design Branch. If this review occurs early in the development's design, access may often be improved with minimal expense. Since the Town is often the first point of contact for developers, the Town should advise them of this requirement and assist in the review.

STATE FUNDING SOURCES

The North Carolina Department of Transportation has several sources for funding highway improvements. The Transportation Improvement Program (TIP) funds major projects of statewide significance. The Secondary Road Improvement Program (SRIP) primarily funds paving of unpaved state-maintained secondary roads, but also may have additional monies for improvements to existing paved roads for safety and maintenance purposes. The Small Urban Fund (SUF) provides monies for low-cost urban projects which may not be addressed by the TIP. The Industrial Access Fund (IAF) can assist municipalities in attracting new industries by providing for access to existing state-maintained roadways.

RECOMMENDED SUBDIVISION ORDINANCES

DEFINITIONS

I. Streets And Roads

A. Rural Roads

1. Principal Arterial - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes, Intrastate routes, and other routes designated as principal arterials.

2. Minor Arterial - A rural roadway joining cities and larger towns and providing intrastate and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

3. Major Collector - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. Minor Collector - A road which provides service to smaller communities and traffic generators and provides access to the Major Collector system.

5. Local Road - A road which serves primarily to provide access to adjacent land, over relatively short distances.

B. Urban Streets

1. Major Thoroughfares - Major thoroughfares consist of Interstate, Intrastate other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of volumes of traffic within and through urban areas.

2. Minor Thoroughfares - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. Local Street - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

C. Specific Type Rural Or Urban Streets

1. Freeway - Divided multilane highway designed to carry large volumes of traffic at higher speeds. A freeway provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. (Design speed 70 mph, operating speed 55 mph to 65 mph.)

2. Secondary Freeway - A divided multilane roadway designed to carry moderate volumes of traffic at moderate speeds. The facility provides for the continuous flow of traffic through full control of access and the provision of interchanges or grade separations with no access at crossroads, and no traffic signals. (Design speed 50 to 55 mph, operating speed 40 to 45 mph.)

3. Parkway - A divided multilane roadway designed for non-commercial traffic, with full or partial control of access. Grade separations are provided at major intersections and there are no traffic signals.

4. Expressway - A divided multilane roadway designed to carry heavy volumes of traffic with full or partial control of access. Interchanges are provided at major intersections. There may be access to service roads and local streets, but there will be no signalized intersections.

5. Secondary Expressway - A divided multilane roadway designed to carry moderate volumes of traffic at moderate speeds. This facility may have partial control of access, with right turn in and right turn out access to abutting property, and interchanges at major intersections. Some minor intersections may have traffic signal control.

6. Urban Arterial - Multilane roadway with signalized intersections, and access to abutting property. May have grass or barrier type median, or middle left turn lane.

7. Residential Collector Street - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

8. Local Residential Street - Cul-de-sacs, loop streets less than 2,500 feet in length, or streets less than one mile length that do not connect

thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

9. Cul-de-sac - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

10. Frontage Road - A road that is parallel to a partial or full access-controlled facility and provides access to adjacent land.

11. Alley - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties abutting on a street.

II. Property

A. Building Setback Line - A line parallel to the street in front of which no structure shall be erected.

B. Easement - A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

C. Lot - A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and parcel".

III. Subdivision

A. Subdivider - Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

B. Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets; provided, however, that the following shall not be included within this definition nor subject to these regulations: (1) the combination or recombination of portions of previously platted lots where the total number of lots is not increased and the resultant lots meet or exceed the standards contained herein; (2) the division of land into parcels greater than ten acres where no street right-of-way dedication is involved; (3) widening of opening of streets; (4) the division of a tract in single ownership whose entire area is no greater than two acres into not more than three lots, where no street right-of-way dedication is

involved and where the resultant lots are equal to or exceed the standards contained herein.

C. Dedication - A gift, by the owner, or his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

D. Reservation - Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

DESIGN STANDARDS

I. Streets And Roads

The design of all roads within the municipality shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway and Transportation Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality.

The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

A. Right-Of-Way Widths - Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

1. Rural	Minimum ROW
a. Principal Arterial	
Freeways	350 feet
Other	200 feet
b. Minor Arterial	100 feet
c. Major Collector	100 feet
d. Minor Collector	80 feet
e. Local Road	60 feet *

2. Urban	Minimum ROW
a. Major Thoroughfares other than Freeways, Expressways, and Parkways	90 feet
b. Minor Thoroughfare	70 feet
c. Local Street	60 feet *
d. Cul-de-sac	Variable **

* The desirable minimum right-of-way (ROW) is 60 feet. If curb and gutter is provided, 50 feet of ROW is adequate on local residential streets.
** The ROW dimension will depend on radius used for vehicular turnaround. Distance from edge of pavement of turnaround to ROW should not be less than distance from edge of pavement to ROW on street approaching turnaround.

The subdivider will only be required to dedicate a maximum of 100 feet of right-of-way. In cases where over 100 feet of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 100 feet. On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than 60 feet in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider, provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is subdivided, the remainder of the full required right-of-way shall be dedicated.

B. Street Widths - Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. Local Residential
Curb and gutter section - 26 feet, face to face of curb
Shoulder section - 20 feet to edges of pavement, 4 foot shoulders

2. Residential Collector
Curb and gutter section - 34 feet, face to face of curb
Shoulder section - 20 feet to edges of pavement, 6 foot shoulders

C. Geometric Characteristics - The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-way Widths shall apply.

1. Design Speed - The design speed for a roadway should be a minimum of 5 mph greater than the

posted speed limit. The design speeds for subdivision type streets shall be:

DESIGN SPEEDS			
Facility Type	Design Speed (mph) Desirable	Minimum Level	Minimum Rolling
Rural			
Minor Collector Roads	60	50	40
Local Roads including Residential Collectors and Local Residentials	50	50*	40*
Urban			
Major Thoroughfares other than Freeways, Expressways, or Parkways	60	50	50
Minor Thoroughfares	60	50	40
Local Streets	40	40**	30**

* Based on projected annual average daily traffic of 400-750. In cases where road will serve a limited area and small number of dwelling units, minimum design speeds can be reduced further.
** Based on projected annual average daily traffic of 50-250.

2. Maximum And Minimum Grades

a. The maximum grades in percent shall be:

MAXIMUM VERTICAL GRADE IN PERCENT		
Design Speed (mph)	Terrain Level	Rolling
60	4	5
50	5	6
40	6	7
30	-	9

b. Minimum grades should not be less than 0.5%

c. Grades for the first 100 feet each way from intersections (measured from edge of pavement) shall not exceed 5.0%.

d. For streets with projected annual average daily traffic less than 250, short grades less than 500 feet long may be 150% of the values in the above table.

3. Minimum Sight Distance - No less than the minimum sight distance as shown below shall be provided. Vertical curves that connect each change in grade shall be provided as calculated using the following parameters:

SIGHT DISTANCE				
Design Speed (mph)	30	40	50	60
Stopping Sight Distance				
Minimum (feet)	200	275	400	525
Desirable (feet)	200	325	475	650
Minimum K* Value For				
Crest Vertical Curve	30	80	160	310
Sag Vertical Curve	40	70	110	160

* K is a coefficient by which the algebraic difference in grades may be multiplied to determine the length in feet of the vertical curve which will provide the desired sight distance.

General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case where used. Sight distance provided for vehicles stopped at intersections shall be in accordance with A Policy on Geometric Design of Highways and Streets (1990).

4. Superelevation - The superelevation table below shows the maximum degree of curve and related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06 with 0.04 being desirable.

SUPERELEVATION TABLE			
Design Speed (mph)	Maximum Superelev (ft/ft)	Minimum Radius (feet)	Maximum Deg of Curv (deg+min)
30	.04	302′	19 00′
40	.04	573′	10 00′
50	.04	955′	6 00′
60	.04	1528′	3 45′
30	.06	273′	21 00′
40	.06	509′	11 15′
50	.06	849′	6 45′
60	.06	1380′	4 15′
30	.08	252′	22 45′
40	.08	468′	12 15′
50	.08	764′	7 30′
60	.08	1206′	4 45′

D. Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street shall intersect any other street at an angle less than sixty-five (65) degrees. No street shall intersect a railroad at grade at an angle less than sixty-five (65) degrees.

2. Property lines at intersections shall be set so that the distance from the edge of pavement, of the street turnout, to the property line shall be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line may be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for a stopped vehicle on the side street.

3. Offset intersections shall be avoided. Intersections which cannot be aligned shall be separated by a minimum length of two hundred (200) feet between survey centerlines.

E. Cul-de-sacs

Cul-de-sacs shall not be more than five hundred (500) feet in length (for control of speed, visual detection of a dead-end street, and for fire protection). The

distance from the edge of pavement on the vehicular turnaround to the right-of-way line shall not be less than the distance from the edge of pavement to the right-of-way line on the street approaching the turnaround. Cul-de-sacs shall not be used to avoid connection with an existing street or to avoid the extension of a important street.

F. Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provision is made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of the alley shall be at least twenty (20) feet.

3. Deadend alleys shall be avoided where possible, but if unavoidable, shall be provided with such adequate turnaround facilities at the dead end as may be required by the Planning Board.

G. Permits For Connection To State Roads

An approved permit is required for connection to any existing State system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division Of Highways.

H. Offsets To Utility Poles

Poles for overhead utilities shall be located clear of roadway shoulders, preferably a minimum of at least thirty (30) feet from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of six (6) feet from the face of curb.

I. Wheelchair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or alterations for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

J. Horizontal Width On Bridge Deck

1. The clear roadway widths for new and reconstructed bridges serving 2-lane, 2-way traffic shall be as follows:

   a. Shoulder Section Approach
      i. Under 800 ADT in design year - Minimum 28 feet width face to face of parapets or rails or pavement width plus 10 feet, whichever is greater.
      ii. 800 to 2000 ADT in design year - Minimum 34 feet width face to face of parapets or rails or pavement width plus 12 feet, whichever is greater.
      iii. Over 2000 ADT in design year - Minimum width of 40 feet with a desirable width of 44 feet face to face of parapets or rails.

   b. Curb And Gutter Approach
      i. Under 800 ADT in design year - Minimum 24 feet face to face of curbs.
      ii. Over 800 ADT in design year - The width of the approach pavement measured face to face of curbs. Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face to face of parapet or rail shall be 1'6" minimum or greater if sidewalks are required.

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic shall be as follows:

   a. Shoulder Section Approach - The width of approach pavement plus width of usable shoulders on the approach left and right. (Shoulder width is 8 feet minimum and 10 feet desirable.)

   b. Curb And Gutter Approach - The width of approach pavement measured face to face of curbs.

THOROUGHFARE CROSS SECTIONS

CROSS SECTION EXPLANATIONS

The typical cross sections for thoroughfares shown in the thoroughfare plan are described below and shown in Figure 6.

Cross Section A shows a controlled-access freeway. The 46-foot grassed median is the minimum width, and 70 feet is desirable. The 228-foot right-of-way width is the minimum, and 300 feet is desirable. Slopes of 8:1 into 3-foot drainage ditches in the median are desirable for traffic safety.

Cross Section B is typical for four-lane divided highways in rural areas which have only partial control of access or none at all. The minimum median with is 30 feet, but wider is desirable. Design requirements for slopes and drainage are similar to Cross Section A.

Cross Section C and Cross Section D are used for major thoroughfares in urban areas where frequent left turns are anticipated because of abutting property development or frequent street intersections.

Cross Section E and Cross Section F are used for major thoroughfares in urban areas where left turns and intersecting streets occur infrequently. Left turns would be restricted to a few selected intersections. These cross sections are not as universal as Cross Sections C and D.

Cross Section G is appropriate for urban boulevards or parkways and is used to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. The minimum median width is 24 feet, and 30 feet is desirable.

Cross Section H is used for major thoroughfares in urban areas where projected travel exceeds the capability of a two-lane or three-lane roadway, left turns are infrequent, and right-of-way is restricted.

Cross Section I is often used for streets which must carry one-way traffic, although it could also be used for an urban thoroughfare with low volumes of traffic but high numbers of left turns.

Cross Section J and Cross Section K are used for minor thoroughfares which serve both traffic and land service functions. Cross Section J provides more parking capacity for thoroughfares which must serve more concentrated development. These sections are rarely appropriate as on-street parking is undesirable.

Cross Section L is used in rural areas or for staged construction of wider multilane roadways. This cross section may be adequate for some thoroughfares where projected travel volumes are low even far into the future.

Cross Section M is used for urban thoroughfares which will serve very high volumes of traffic. Left turn lanes would be provided in the raised median area at major intersections.

Cross Section N is used for segments of freeway which will carry higher volumes of traffic than Cross Section A. The minimum median width is 30 feet, but 70 feet is desirable.

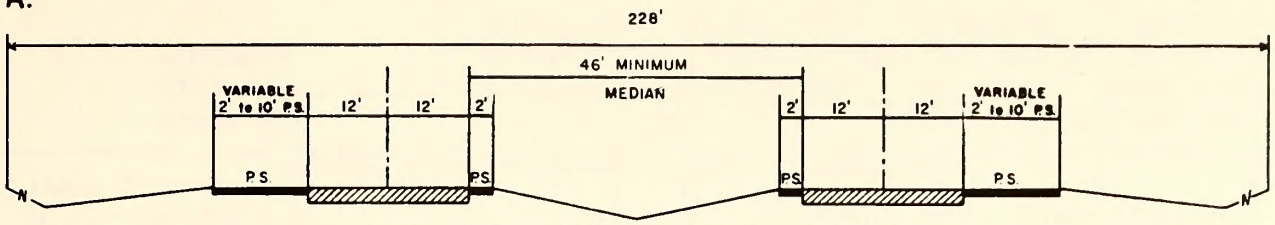
The curb and gutter urban cross sections show the sidewalks adjacent to the curb with a utility strip between the sidewalk and the right-of-way line. This spacing permits adequate setback for utility poles. If the sidewalk is moved away from the street to provide separation for pedestrians or for aesthetic purposes, then additional right-of-way must be added to insure sufficient setback for utility features.

The right-of-way shown for the typical cross sections is the minimum required to contain the street, sidewalks, utilities, and drainage structures. Topography, geology, and cut and fill requirements often require additional right-of-way, or construction easements. Recommended cross sections for thoroughfares were derived from projected traffic, existing capacities, desired levels of service, and available right-of-way. Table 4 in Appendix B shows the ultimate required right-of-way for the various thoroughfares, and this value supersedes the general values shown in Figure 6.

If sufficient bicycle traffic along the thoroughfare exists to justify a bike lane or bikeway, then additional right-of-way must be added to accommodate bicycle facilities. The Guide for the Development of Bicycle Facilities (1991) by the American Association of State Highway and Transportation Officials (AASHTO) provides information on design standards for bicycle facilities.

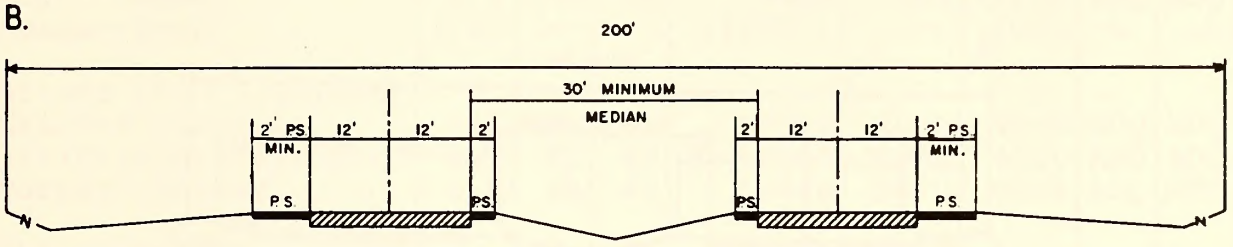
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



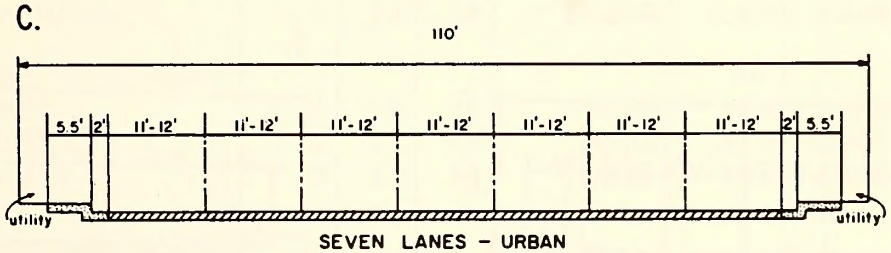
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



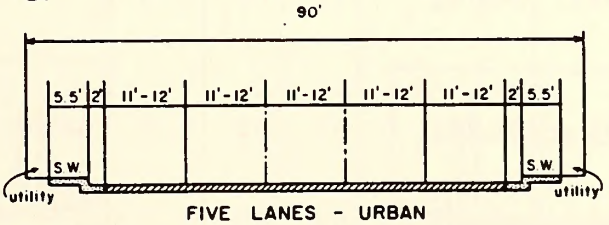
FOUR LANES DIVIDED WITH MEDIAN - RURAL

C.



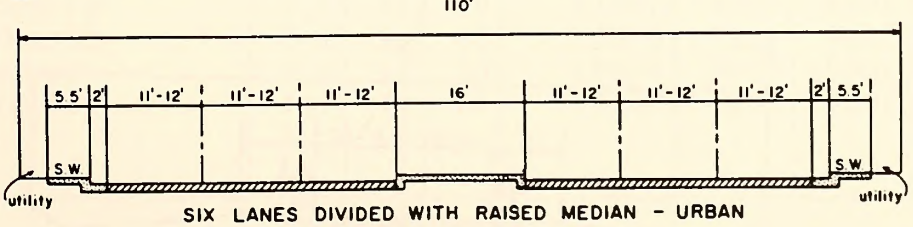
SEVEN LANES - URBAN

D.



FIVE LANES - URBAN

E.

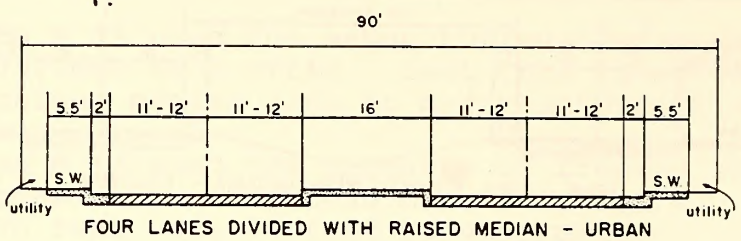


SIX LANES DIVIDED WITH RAISED MEDIAN - URBAN

FIGURE 6

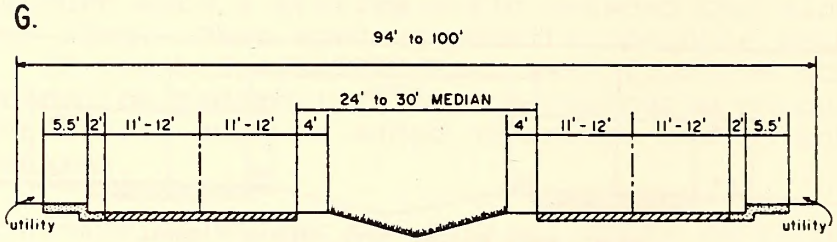
TYPICAL THOROUGHFARE CROSS SECTIONS
(CONTINUED)

F.



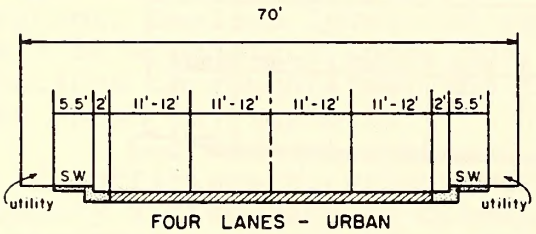
FOUR LANES DIVIDED WITH RAISED MEDIAN - URBAN

G.



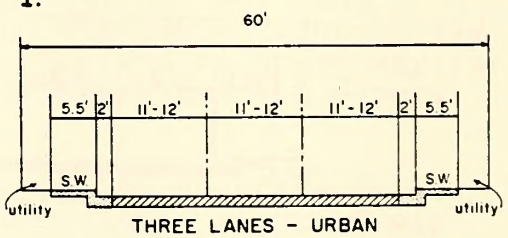
FOUR LANES DIVIDED - URBAN BOULEVARD
GRASS MEDIAN

H.



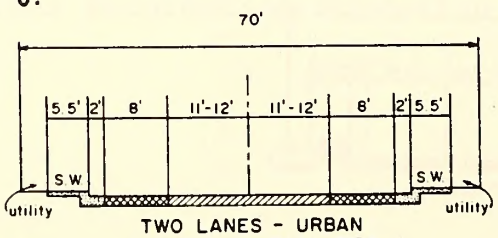
FOUR LANES - URBAN

I.



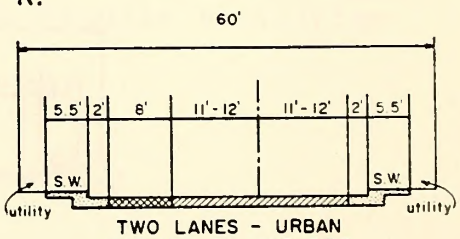
THREE LANES - URBAN

J.



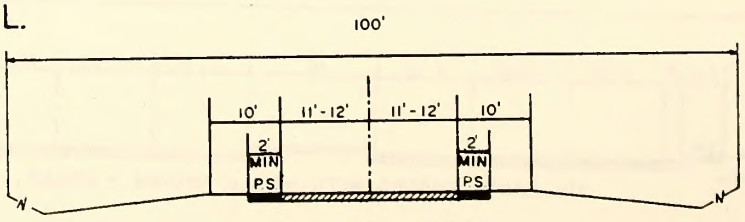
TWO LANES - URBAN
PARKING ON EACH SIDE

K.



TWO LANES - URBAN
PARKING ON ONE SIDE

L.



TWO LANES - RURAL

TABLE 4
FOUR OAKS THOROUGHFARE PLAN STREET TABULATION AND RECOMMENDATIONS

ROADWAY SEGMENT from--to	EXISTING X-SECTION DIST mi	PAV ft	ROW ft	EXISTING CAPACITY [FUTURE] vpd	AVERAGE DAILY TRAFF VOLUMES 1990	2010	RECOMM X-SECT PAV fig	ROW ft
Adams Street (SR1178)								
NC96--SR1225	0.7	20	60	11000	900	2000	ADQ	ADQ
SR1225--Wellons	0.6	20	40	10000	2500	4500	ADQ	ADQ
Allendale Rd (SR1164)								
Main--Adams	0.4	18	40	8000	500	1000	ADQ	ADQ
Adams--Keen	[.2]	--	--	[10000]	--	1000	L	60
Hatcher St (SR1162)								
Main--Strickland	0.1	20	48	10000	2000	4000	ADQ	ADQ
Strickland--Parker	0.2	20	40	10000	2000	4000	ADQ	ADQ
Parker--SR1348	1.0	20	60	11000	2000	4000	ADQ	ADQ
Interstate Hwy (I95)								
SR1207--US701	3.9	96	260	54000	23700	35000	ADQ	ADQ
Keen Street (SR1182)								
SR1164EXT--US301	1.9	20	34	11000	500	1000	ADQ	ADQ
Lewis Street (SR1350)								
SR1364--Tart	0.8	18	70	9000	900	2000	ADQ	ADQ
Tart--Church	0.1	18	46	8000	900	2000	ADQ	ADQ
Church--Maple	0.3	18	30	8000	900	2000	ADQ	ADQ
Main Street (SR1162)								
SR1160--Allen	2.0	20	50	11000	1100	2500	ADQ	ADQ
Allen--Woodall	0.2	40	46	16000	1700	3500	ADQ	ADQ
Woodall--Sanders	0.2	46	52	22000	2800	5000	ADQ	ADQ
Sanders--Hatcher	0.3	37	47	16000	2500	4500	ADQ	ADQ
Moore Street								
Wellons--N. Railroad	[.1]	--	--	[10000]	--	1000	L	60
North Railroad--Maple	0.3	18	40	8000	500	1000	ADQ	ADQ
Sanders St (SR1183)								
Main--Moore	0.4	20	40	10000	1200	2500	ADQ	ADQ
Moore--SR1346	2.3	20	60	11000	1000	2000	ADQ	ADQ
Wellons Street (US301)								
SR1166--Temple	2.1	24	70	13000	3900	8000	ADQ	ADQ
Temple--Church	0.1	24	60	12000	4100	8000	ADQ	ADQ
Church--Adams	0.4	44	60	16000	9000	15000	ADQ	ADQ
Adams--SR1182	1.9	44	65	16000	4200	7000	ADQ	ADQ

TABLE 4
FOUR OAKS THOROUGHFARE PLAN STREET TABULATION AND RECOMMENDATIONS

ROADWAY SEGMENT from--to	EXISTING X-SECTION DIST mi	PAV ft	ROW ft	EXISTING CAPACITY [FUTURE] vpd	AVERAGE DAILY TRAFF VOLUMES 1990	2010	RECOMM X-SECT PAV fig	ROW ft
Western Loop Road								
Main--Wellons	[.9]	--	--	[13000]	--	7000	L	100
Wellons--Lewis	[.8]	--	--	[13000]	--	7000	L	100
Lewis--Hatcher	[.6]	--	--	[13000]	--	5000	L	100
Hatcher--Sanders	[1.3	--	--	[13000]	--	5000	L	100

ABBREVIATIONS:
ADQ = adequate
DIST = distance
PAV = pavement
ROW = right-of-way
UNK = unknown
X-SECT = cross section
fig = figure
ft = feet
mi = mile
vpd = vehicles per day
NOTE:
Although a roadway may be listed as adequate (ADQ), all pavements should be widened to achieve the standard 12-foot lane width.